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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G06K 9/03, B41F 33/00 — A1

(11) International Publication Number: WO 97/31332

(43) International Publication Date: 28 August 1997 (28.08.97)

(21) International Application Number: PCT/GB97/00522

(22) International Filing Date: 25 February 1997 (25.02.97)

(30) Priority Data:
9603998.7 26 February 1996 (26.02.96) GB

(71) Applicant *(for all designated States except US)*: DOMINO PRINTING SCIENCES PLC [GB/GB]; Bar Hill, Cambridge CB3 8TU (GB).

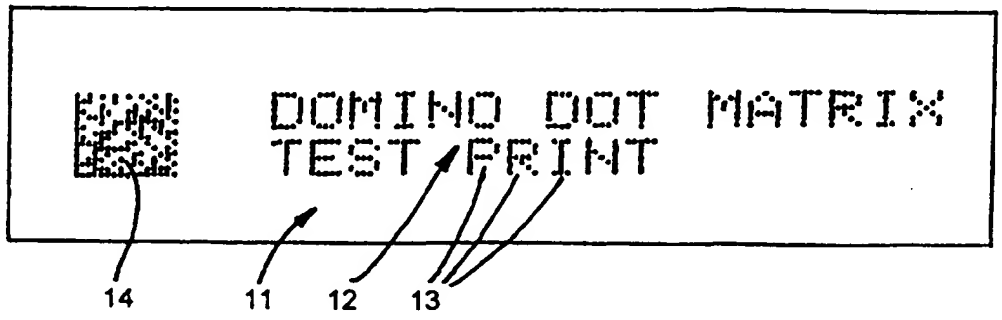
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: SQUIRES, Robert [GB/GB]; 29 Pennington Road, Hartford, Huntingdon, Cambridgeshire PE18 7QF (GB).

(74) Agent: GILL JENNINGS & EVERY; Broadgate House, 7 Eldon Street, London EC2M 7LH (GB).

(81) Designated States: US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: METHOD OF AND APPARATUS FOR PRINT VERIFICATION



(57) Abstract

A method and apparatus for verifying the readability of character based human-readable code printed by a dot matrix printer. The method comprises the steps of printing the character-based human-readable code with the printer, printing a corresponding dot code immediately alongside the character-based code, and scanning and verifying the dot code by machine. The apparatus comprises means for performing the above steps.

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METHOD OF AND APPARATUS FOR PRINT VERIFICATION

The present invention relates to a method and apparatus for verifying the quality of printed characters and, more particularly, for verifying the readability of characters.

Many products are now required to carry printed character-based information, for example, "Best before Date" , "Date of Manufacture", "Batch Number" characters etc. Whilst such data may be emboss-coded for reliability, inkjet printing is another method of applying such characters. It is likely that in the near future, in some product areas, particularly "Food & Drugs", regulations will be implemented regarding verification of such printed data, to ensure that the data is legibly printed. It is expected that present-day "Current Good Manufacturing Practice" (CGMP) requirements will be adopted. These specify that codes or data must be inspected 200% (ie twice) if verified by human eye or 100% if verified by electronic inspection systems.

The inspection of embossed codes is difficult due to poor contrast between the codes and the background and this makes systems for automatic verification expensive. However, even systems for inspection/verification of inkjet-printed codes are expensive due to the requirement to accurately 'read' individual characters.

There is a need therefore for an improved method and apparatus which can accurately verify character codes but which is not expensive.

According to the present invention there is provided a method in which, a dot matrix printer is used, as well as for printing a character-based human-readable code, also for printing a corresponding dot code immediately alongside the character-based code, and the dot code is scanned and verified by machine.

The printer may be an ink jet printer, say of drop-on-demand or continuous type, or may be a conventional

impact printer, but any type of dot matrix printer, ie one in which characters or marks are made by a plurality of individual pixels or dots, may be used. Preferably, however, the printer is one in which individual pixels or drops at a particular position in the print are printed from a single respective print element. This maximises detection of errors in the human-readable code.

Preferably, the dot code is printed after the character-based code, so that deterioration of printing during the printing process affects the dot code more seriously. However, identical dot codes may be printed both on each side of the human-readable data, ie both before and after printing of the character-based, human-readable code, for added security, as erratic printing errors may be detected more easily and differences between the dot codes printed can be used as a determination of printing errors.

Dot codes are not capable of being read easily by the human eye, but can provide a large amount of information in a small space. Systems exist for accurate interpretation of dot-coded data which are considerably cheaper than verification systems for character-based codes, because they do not need to 'interpret' the characters. However, because, in order to be decoded, dot codes must be highly accurately formed, the readability of the dot code can be used to verify the readability of the character-based code adjacent to it. In other words, if the dot code can be decoded meaningfully by the system, then it can be ensured that the character-based code is legible.

The invention relies on the fact that if the inkjet or other dot matrix printer fails to print correctly the dots which it uses to form the character-based, human-readable codes and the dot codes, the dot code will be detected as having deteriorated, before the character-based data is illegible to the human eye, since machine decoding of the dot codes is more sensitive to errors than

the human reading of the character-based code is to errors detected by the human eye and brain which can 'interpret' characters which are quite badly misformed. Thus, the system can be extremely sensitive and can provide a measure of verifiability which errs on the side of caution.

Apparatus according to the invention may comprise a dot-matrix printer adapted to print a dot code immediately adjacent a character-based, human-readable code and means for reading the dot code to determine its readability, non-readability of the dot code being used to indicate illegibility of the character-based code. Non-readability may be determined in accordance with asuitable algorithm, so that a predetermined degree of non-readability is required before the character-based code is determined to be illegible.

One example of an apparatus and method according to the present invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 illustrates the juxtaposition of a character-based, human-readable code and a dot code on a label;

Figure 2 illustrates apparatus for reading the dot codes and rejecting items with labels having degraded dot codes.

In figure 1 a character-based, human-readable code 12, in this example formed by conventional alphanumeric characters 13, is shown juxtaposed to a dot code 14 on a label 11. In practice, the label 11 will be one of a series attached to packages(not shown in figure 1), for example which contain pharmaceutical products, to provide information to the user, via the alphanumeric characters, as to the content, etc. of the package. The codes will be applied to the labels 11 either before or after attachment of the labels, but usually during the production process, so that the information on the labels is contemporaneous with the filling of the packages.

Preferably the codes are applied by a continuous ink-jet printer which can achieve the very high speed printing required to keep pace with a production line. In an alternative embodiment, not shown, the character-based and dot codes may be applied directly to the packages. Although the dot code 14 is shown printed to one side of the character-based code 12, identical dot codes could be printed on each side of the human-readable data, ie both before and after printing of the character-based code, for added security.

The apparatus comprises a vision system 1-6 (for example a DMR 600 high performance data matrix reader from Acuity Imaging Inc.) having a CCD camera 1 which is focussed on the production line so as to view the labels 11 of the individual packages 15 as they pass by the camera, together with circuitry which includes image capture hardware 2. Threshold analysis, conversion of the image to a bit image and decoding are achieved in components 3,4,5 respectively, which may alternatively be a PC or PLC (programmable logic controller).

The images of the dot codes from the CCD camera 1 are translated, using threshold analysis, and converted to bit images which are then decoded to determine the data that has been decrypted from the encrypted dot codes. When the bit image is decoded, there may be bits which are set when they should not be set or bits that are clear (not set) but which should be set and this information is used in the decoder 5 to determine the clarity of the dot code by means of a complex, but known, algorithm.

The output of the decoder 5 is applied to an error threshold level detector 6 and, depending on the output level, ie whether the number of errors detected by the detector 6 is above or below a preset threshold level, a signal is provided or not respectively to a reject mechanism 7 of an appropriate form which will depend on the package shape, size, strength etc.

The reject mechanism 7 will be actuated to remove packages from the production line according to the preset error threshold, so that these can either be re-labelled or else checked visually by a human operator. Since rejection will occur long before the quality of the human readable has deteriorated to the point where it is illegible to the human brain, a substantially fail-safe readability system can be provided.

CLAIMS

1. A method for verifying the readability of character based human-readable code printed by a dot matrix printer, the method comprising the steps of:

printing the character-based human-readable code with the printer;

printing a corresponding dot code immediately alongside the character-based code; and

scanning and verifying the dot code by machine.

2. A method according to claim 1, wherein the printer is an ink jet printer.

3. A method according to claim 1, wherein the printer is a drop-on-demand printer.

4. A method according to claim 1, wherein the printer is a continuous type printer.

5. A method according to claim 1, wherein the printer is a conventional impact printer.

6. A method according to any of the preceding claims, wherein the printer is one in which individual pixels or drops at a particular position in the print are printed from a single respective print element.

7. A method according to any of claims 1 to 6, wherein the dot code is printed after the character-based code.

8. A method according to any of claims 1 to 6, wherein identical dot codes are printed both on each side of the human-readable data.

9. An apparatus as for verifying the readability of character-based human-readable code, the apparatus comprising:

a dot-matrix printer adapted to print a dot code immediately adjacent the character-based, human-readable code; and

means for reading the dot code to determine its readability, non-readability of the dot code being used to indicate illegibility of the character-based code.

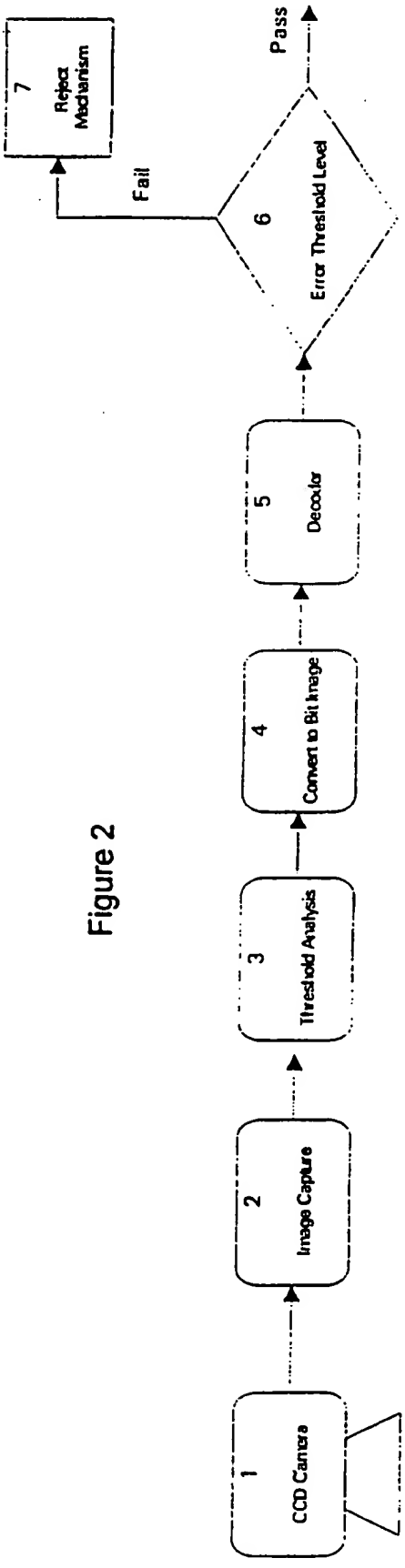

Figure 2

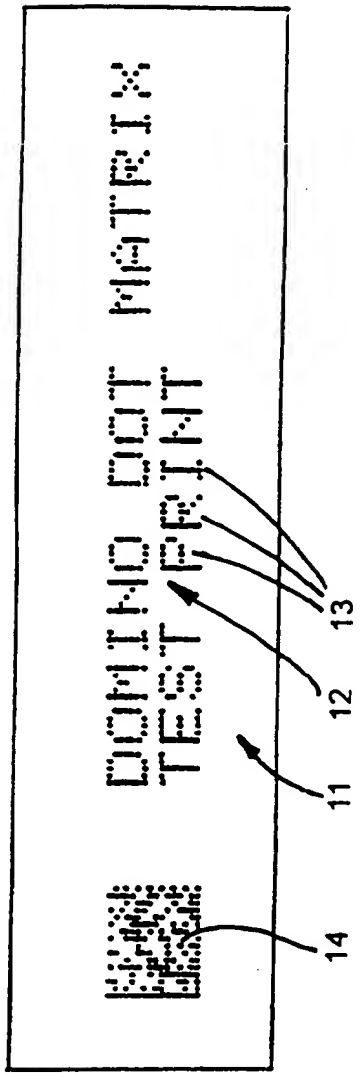

Figure 1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/00522

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K9/03 B41F33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 20, no. 11b, April 1978, NEW YORK US, page 4891 XP002031632 D. S. GARRISS: "BAR-CODED DELIMITERS FOR OCR-CODED INFORMATION" see the whole document ---	1-9
X	EP 0 592 238 A (MATSUSHITA ELECTRIC IND CO LTD) 13 April 1994 see page 4, line 3 - line 12 ---	1-9
A	WO 95 00337 A (ANALYTIC SCIENCES CORP) 5 January 1995 see abstract -----	1-9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
28 May 1997	12.06.97

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 97/00522

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0592238 A	13-04-94	JP 6282679 A	07-10-94
		US 5625721 A	29-04-97
WO 9500337 A	05-01-95	NONE	